CLAIMS

1. A method for reducing bias error in a Vibrating Structure Gyroscope having a vibrating structure, primary drive means for putting the vibrating structure into carrier mode resonance, primary pick-off means for sensing carrier mode motion, secondary pick-off means for sensing response mode vibration of the vibrating structure in response to applied rotation rate, secondary drive means for applying a force to control the response mode motion, closed loop primary control loops for maintaining a fixed amplitude of motion at the primary pick-off means and for maintaining the drive frequency at the resonance maximum, and secondary control loops and for maintaining a null at the secondary pick-off means, in which the ratio SF_{QUAD} divided by $SF_{IN\text{-}PHASE}$ is measured from the secondary control loop to provide a direct measurement of Sin ($\phi_{SD} \div \phi_{PPO}$), according to the relationship;

$$SF_{QUAD} = SF_{IN\text{-}PHASE} \times \text{Sin}\,(\phi_{SD} + \phi_{PPO})$$

where SF_{QUAD} is the quadrature scalefactor, $SF_{IN\text{-}PHASE}$ is the in-phase scalefactor, ϕ_{SD} is the phase error in the secondary drive means and ϕ_{PPO} is the phase error in the primary pick-off means, the total phase error ϕ_E is obtained directly from the measured Sin ($\phi_{SD} + \phi_{PPO}$) according to the relationship;

$$\phi_E = \phi_{SD} + \phi_{PPO}$$

and phase corrections applied to the secondary drive means and/or primary pick-off means to reduce the phase error ϕ_E and hence the quadrature bias error to enhance the performance of the gyroscope.

2. A method according to Claim 1, when used with a gyroscope having a silicon vibrating structure.

3. A method according to Claim 2, when used with a gyroscope having a substantially planar, substantially ring shaped vibrating structure.

4. A method according to any one Claims 1 to 3, when used with a gyroscope having analogue primary and secondary control loops with

variable value capacitors, in which the phase corrections are applied by varying the values of the variable value capacitors in the secondary control loop relating to the secondary drive means and/or the values of the variable value capacitors in the primary control loop relating to the primary pick-off means to adjust ϕ_{SD} and/or ϕ_{PPO} such that ϕ_E is minimised in value.

5. A method according to any one of Claims 1 to 3, when used with a gyroscope having digital primary and secondary control loops, in which the phase corrections equal to ϕ_E are applied to the secondary drive means via the secondary control loop in a manner such as to cross-couple in-phase and quadrature drive channels by an amount equal and opposite to the combined effect of the phase errors in the vibrating structure control system.

6. A method according to any one of Claims 1 to 3, when used with a gyroscope having digital primary and secondary control loops, in which the phase corrections equal to ϕ_E are applied to the primary pick-off means by the primary control loop in a manner such as to cross-couple in-phase and quadrature drive channels by an amount equal and opposite to the combined effect of the phase errors in the vibrating structure control system.

7. A method according to Claim 4 or Claim 5, in which in-phase and quadrature signal components are each multiplied by Sin ϕ_{CORR} and Cosϕ_{CORR}, where ϕ_{CORR}, is the phase correction, and the effective phase of each in-phase and quadrature channel adjusted according to the summations.

$$\text{Quadrature}_{CORR} = \text{Quadrature} \times \text{Cos}\phi_{CORR} + \text{In-phase} \times \text{Sin}\phi_{CORR}$$

and

$$\text{In-phase}_{CORR} = \text{In-phase} \times \text{Cos}\phi_{CORR} - \text{Quadrature} \times \text{Sin}\phi_{CORR}.$$

8. A method according to Claim 6, in which ϕ_{CORR} is adjusted in accordance with operating temperature of the gyroscope to maintain ϕ_E at a minimised value.

9. A method for reducing bias error in a Vibrating Structure Gyroscope, substantially as hereinbefore described and as illustrated in Figures 4, 5, or 6 as modified or not by Figures 1, 7, 8 or 9 of the accompanying drawings.

10. A Vibrating Structure Gyroscope operated according to the method of any one of claims 1 to 8.